Minimally Invasive Heart Valve Surgery Technique Overview

TECHNIQUES FOR MINIMALLY INVASIVE MITRAL VALVE REPAIR/REPLACEMENT

Michael Moront, MD

Academia Medical Education
What is a Minimally Invasive Mitral Valve Repair/Replacement (MVR) Procedure?

The procedure described here is a minimally invasive direct vision approach for MVR. The procedure is performed under direct vision through a right lateral mini-thoracotomy and achieved by creating a 6-7 cm incision in the 4th or 5th intercostal space (ICS) and using an atrial retractor to improve visibility. Arterial and venous cannulation are performed through the femoral artery and vein, respectively.

Potential Benefits of Minimally Invasive MVR

- Reduced trauma and pain
- Statistically decreased blood loss and transfusion requirements
- Statistically reduced recovery time and more rapid return to work
- Better cosmetic results and improved patient satisfaction
- No difference in morbidity and mortality
- Facilitates redo surgery
- Avoids sternal wound complications
- Statistically reduced incidence of wound infections

NOTE: The views and techniques expressed herein and in the training are the views of Dr. Moront. This information is provided as a general resource, but is not intended to constitute medical advice or in any way replace the independent medical judgment of a trained and licensed physician with respect to any individual patient needs or circumstances. Please see the Instructions for Use for all product indications, contraindications, precautions and adverse events.
1. PATIENT SELECTION

Exclusion criteria
• Severely calcified ascending aorta
• Severely calcified or obstructed femoral arteries
• Prior surgery or inflammatory process in right chest
• Presence of an inferior vena caval umbrella
• Presence of known femoral chronic deep venous thrombosis
• Severe pectus deformity of the chest

Alternative approach: Redo with prior coronary artery bypass grafting can be performed with heart fibrillating.

2. ANESTHESIA TECHNIQUE

• Double lumen endobronchial tube or bronchial blocker endotracheal tube
• Swan-Ganz® pulmonary artery catheter
• Transesophageal echocardiography (TEE)
• Measure left atrium dimensions for sizing of MitraX® retractor
• Radial and femoral arterial lines

3. PATIENT POSITIONING

• Modified left lateral decubitus position
• Place roll behind the tip of scapula, elevating the right chest
• Position right arm at a 45° angle off to the side of the bed
• In female patients the incision is marked in the right inframammary fold but the breast is moved superiorly following topical prep and secured in place by a second steri-drape (this moves the inframammary fold into the 4th and 5th ICS)
• Prep and drape in usual fashion

4. CANNULATION

• Performed prior to thoracotomy
• Left femoral artery and vein cannulation are performed utilizing a Seldinger technique (only limited exposure is required to identify the anterior aspect of the vessels)
• Perform arterial cannulation first, the cannula should never be forced and should advance easily
• Insert femoral venous guideware from the femoral vein into the superior vena cava (SVC) utilizing transesophageal echocardiography (TEE) guidance
• Verify wire location in SVC prior to passing cannula (very important)
• Ultimately, the femoral venous cannula tip should be in the lower right atrium
• An additional venous line is added for transthoracic SVC cannulation

If there is resistance while passing the cannula, immediately abandon and insert via a right percutaneous approach. Left atrial sizes and mitral valve annular diameter is assessed prior to cardiopulmonary bypass and the appropriate size MitraX intra-atrial retractor is selected and prepared.
5. INCISION AND EXPOSURE

- Lateral to the anterior axillary line, chest incision in 4th or 5th ICS, 5-6 cm long

**In female patients**, the right inframammary line is entered
- Use soft tissue retractor and rib retractor to obtain further exposure
- Make a chest tube incision and pass through the following:
  1. Carbon dioxide blower (infuse at 2 L/min throughout the operation)
  2. Cardiotomy suction
  3. Diaphragmatic suture (placed and tied on the tendinous portion of the diaphragm)
  4. Pericardial tacking suture on right lower aspect of the pericardium
- Open the pericardium approximately 2-3 cm above the phrenic nerve
- Place a pericardium retraction suture on the lower most portion of the pericardium and exit through the chest tube incision (as previously described)
- Place additional pericardial sutures and tack to skin to help retract the heart towards the incision

6. SVC CANNULATION AND CARDIOPLEGIA

- SVC is cannulated directly with a 18-22 Fr flexible venous cannula for additional exposure and improved venous drainage
- Insert retrograde cardioplegia cannula into the coronary sinus utilizing TEE guidance
- Institute cardiopulmonary bypass
- Develop a plane between the inferior aspect of the aorta and the superior aspect of the right pulmonary artery with electrocautery
- A cardioplegia-aortic vent cannula is placed in the ascending aorta
- Cross clamp the ascending aorta directly through the incision utilizing a flexible cross clamp in the previously developed plane
- Antegrade and retrograde cardioplegia are administered in a standard fashion
- The patient’s body temperature is kept at 36° centigrade
7. ATRIOTOMY
- Develop the right intra-atrial groove
- Open the left atrium
- Insert MitraX® (self-adjusting retractor) and access mitral valve

8. VALVE REPAIR OR REPLACEMENT
- Inspect the mitral valve leaflets and test the valve with saline infusion to determine repair or replacement
- Place all of the annular sutures to aid in exposure and visualization of the valve prior to performing your valve repair or replacement technique of choice
- Utilize standard repair and replacement techniques
Refer to the “Instructions for Use” which accompany Medtronic heart valve repair and replacement products. Use only those sizers/obturators designed for the product being implanted. Product implant guides available upon request.

9. CLOSING
- Close the atriotomy using running suture line
- Place a single intramyocardial pacing wire in the anterior right ventricular free wall prior to removing the aortic cross clamp
  - Tunnel this pacing wire subcutaneously out the medial aspect of the thoracotomy wound
  - Place a grounding wire
- Place patient in steep Trendelenburg position and inflate the lungs
- Remove cross clamp
- Place a de-airing needle in the root of the aorta and de-air the heart in the usual fashion utilizing TEE guidance
  - Shake patient or compress the chest if needed for de-airing (avoid direct manipulation of the heart)
- Place two atrial pacing wires on the right atrium
- Wean patient from cardiopulmonary bypass
- After protamine administration is complete remove femoral venous arterial cannula
- Place only one chest tube in the right pleural space, leaving pericardium open for drainage
- Give a bolus of local anesthesia into the ICS

10. END OF PROCEDURE
- Two pericostal sutures of #2 Vicryl™ are placed to close the mini-thoracotomy incision
- An On-Q® pain pump system is inserted into the subpleural space at the lateral aspect of the thoracotomy and a second catheter is inserted into the neurovascular bundle of the upper rib of the thoracotomy
- The endobronchial tube is replaced with a standard endotracheal tube
HOW DO I BEGIN?

Medtronic offers peer-to-peer education for those interested in learning how to do an MVR procedure. Please contact your CardioVascular sales representative for more information.

**Instruments and Disposables* as typically used by Dr. Moront**

1. Prosthetic Valve – Medtronic Mosaic® Bioprosthesis
2. Repair Products – CG Future® COMPOSITE Ring or CG Future® Band, Profile 3-D Annuloplasty Ring.
3. Reusable Instruments
   a. Minimally Invasive Rib Retractor System
   b. Minimally Invasive Atrial Retractor Set, Large Blades
   c. Minimally Invasive Flexible Aortic Clamp
   d. Minimally Invasive Knot Pusher
   e. Minimally Invasive Scissors, Curved
   f. Minimally Invasive Scissors, 30°
   g. Minimally Invasive Needle Drivers, Curved Locking (Qty. x 2)
   h. Minimally Invasive Forceps Straight, Double Action (Qty. x 2)
   i. Forceps Narrow Straight, Double Action
   j. Minimally Invasive Hook (Qty. x 2)
3. Reusable Instruments (continued)
   k. Minimally Invasive Flush Port Adapter
   l. Minimally Invasive Instrument Tray
4. Disposable Supplies
   a. Alexis® Soft Tissue Retractor, Medium
   b. Mitrax® Atrial Retractor – Sizes A, A+, B, B+
   c. Minimally Invasive Aortic Clamp Inserts
   d. Cannulae:
      - Medtronic Bio-Medicus® Multi-Stage Femoral Venous Cannulae, 21 and 25 Fr.
      - Medtronic Bio-Medicus Femoral Arterial Cannula 17, 19, and 21 Fr.
      - Gundry® Silicone RCSP Cannula with Manual-Inflate Cuff, 15 Fr.
      - DLP® Malleable Single Stage Venous Cannula
      - DLP® Aortic Root Cannula, 14ga.
   e. On-Q® pain pump system

* The instruments/disposables listed are in addition to essential instruments necessary to perform surgery.

Over 35 years of scientific innovation, resulting in more options for minimally invasive heart valve repair and replacement.
Mosaic® Porcine Bioprosthesis

**Indications:** For the replacement of malfunctioning native or prosthetic aortic and/or mitral heart valves. **Contraindications:** None known. **Warnings/Precautions/Adverse Events:** Accelerated deterioration due to calcific degeneration of bioprosthesis may occur in: children, adolescents, young adults, and patients with altered calcium metabolism (e.g., chronic renal failure, hyperparathyroidism). Adverse events can include: angina, cardiac arrhythmia, cardiac dysrhythmias, death, endocarditis, heart failure, hemolysis, hemolytic anemia, hemorrhage, transvalvular or paravalvular leak, myocardial infarction, nonstructural dysfunction, stroke, structural deterioration, thromboembolism, or valve thrombosis.

For additional information, please refer to the Instructions For Use provided with the product.

**CAUTION:** Federal law (USA) restricts this device to sale by or on the order of a physician.

CG Future® Annuloplasty System, Profile 3D® Annuloplasty System

**Indications:** This device is indicated for the reconstruction and/or remodeling of pathological mitral valves. Valvular insufficiency and/or stenosis may be corrected by appropriate repair and annular remodeling. **Contraindications:** Heavily calcified valves, valvular retraction with severely reduced mobility, active bacterial endocarditis. **Warnings/Precautions/Adverse Events:** Only physicians who have received proper training in valve repair should use this device. Adverse events can include: thromboembolic events, dehiscence, hemolysis, stenosis, residual incompetence, heart block, endocarditis, systolic anterior motion, left ventricular outflow tract obstruction, anticoagulant-related bleeding or hemorrhage. For additional information please refer to the Instructions for Use provided with the product or contact your local Medtronic representative. **CAUTION:** Federal law (USA) restricts this device to sale by or on the order of a physician.

Bio-Medicus® Femoral Arterial Cannula

**Indication:** These devices are to be used by a trained physician only. Cannulae are used to cannulate vessels, perfuse vessels or organs and/or connect with accessory extracorporeal equipment. The cannula obturator is intended to facilitate proper insertion and placement of the appropriate sized cannula within the vessel for cardiopulmonary bypass. **Contraindication:** Alone, the cannula and obturator are not medical treatment devices. There are no known contraindications for the use of the cannula other than those generally contraindicated for cardiopulmonary bypass. The cannula obturator is to be used only with the appropriate sized Bio-Medicus Cannula. These devices are not intended for use except as indicated above.

DLP® Malleable Single Stage Venous Cannula

**Indication:** These cannulae are intended for collection of venous blood from the right side of the heart via the superior and inferior vena cava during cardiopulmonary bypass surgery up to six hours or less. **Contraindication:** This device is not intended for use except as indicated above.

Bio-Medicus® Multi-Stage Femoral Cannula and Introducer

**Product Description:** Femoral Cannula and Introducer (all contents are STERILE/single use only). **Indications for Use:** These devices are to be used by a trained physician only. Cannulae are used to cannulate vessels, perfuse vessels or organs and/or connect with accessory extracorporeal equipment. The Cannula Obturator is intended to facilitate proper insertion and placement of the appropriate sized cannula within the vessel for cardiopulmonary bypass. **Contraindications:** Alone, the cannula and obturator are not medical treatment devices. There are no known contraindications for the use of the cannula other than those generally contraindicated for cardiopulmonary bypass. The cannula obturator is to be used only with the appropriate sized Bio-Medicus® Cannula. These devices are not intended for use except as indicated above.

DLP® Aortic Root Cannula

**Product Description:** The Aortic Root Cannula consists of flexible tubing permanently attached to both the inlet and tip. The inlet fitting is a female luer fitting. The introducer is packaged within the cannula body. Sterile, nonpyrogenic, single use. **Indications for Use:** This cannula is intended for short term use (six hours or less) in conjunction with cardiopulmonary bypass surgery for delivering cardioplegia solutions. The cannula may also be used to aspirate air from the aorta at the conclusion of the bypass procedure. **Contraindications:** This device is not intended for use except as indicated above.

DLP®/Gundry® Retrograde Coronary Sinus Perfusion Cannula with Manual-Inflate Cuff

**Product Description:** The cannula consists of a wirewound silicone cannula body with a beveled tip (6-Fr models have a non-wirewound cannula body). Two side holes are present near the tip. The back of the cannula body terminates in a locking female luer. A pressure monitoring line is an integral part of the cannula body, beginning at the tip and terminating in a locking female luer fitting or 3-way stopcock with a locking female luer fitting. An inflatable balloon is located at the distal beveled tip. Models 94006, 94010, and 94015 do not have a stylet. The inflation assembly is located at the back of the cannula body and contains a female slip luer and a one-way valve assembly. Sterile, nonpyrogenic, single use. **Indications for Use:** The cannula is intended for use during cardiopulmonary bypass surgery up to six hours or less for the delivery of cardioplegia retrogradely through the coronary sinus. **Contraindications:** This device is not intended for use except as indicated above.

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